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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/652,786	08/29/2003	Dongshan Fu	ACCL-125 (63564-060)	3402

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EXAMINER

KAO, CHIH CHENG G

ART UNIT	PAPER NUMBER
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2882

DATE MAILED: 01/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

10/652,786

**Applicant(s)**

FU ET AL.

**Examiner**

Chih-Cheng Glen Kao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 23 August 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-37 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-20 is/are allowed.
- 6) ☒ Claim(s) 21,23-25 and 34 is/are rejected.
- 7) ☒ Claim(s) 22,26-33 and 35-37 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>4/16/04</u> . | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Oath/Declaration***

1. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

The oath or declaration is defective because:

It does not identify the mailing address of each inventor. A mailing address is an address at which an inventor customarily receives his or her mail and may be either a home or business address. The mailing address should include the ZIP Code designation. The mailing address may be provided in an application data sheet or a supplemental oath or declaration. See 37 CFR 1.63(c) and 37 CFR 1.76.

### ***Drawings***

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the claimed subject matter of claims 4 and 24 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the

drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### *Specification*

3. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction by including the claimed subject matter of claims 4 and 24 is required.
4. The disclosure is objected to because of the following located informalities: (page 11, line 2, " $(r, \theta_B)$ ") which may have intended to be  $-(r_A, \phi_A)-$ ). Appropriate correction is required.
5. The disclosure is objected to because "ACCL-127", as exemplified on the last line of page 12, is not named in such a way for one in the general public to easily locate. Appropriate correction for all instances of "ACCL-127" is required.

*Claim Objections*

6. Claims 1, 3, 11, 14, 18, 20-22, 30, and 35 are objected to because of the following informalities, which appear to be minor draft errors including grammatical and lack of antecedent basis problems.

In the following format (location of objection; suggestion for correction), the following suggestions may overcome their respective objections: (claim 1, line 9, "said parameters"; inserting -in-plane and out-of-plane- before "parameters"), (claim 1, line 9, "the difference"; replacing "the" with -a- ), (claim 1, line 12, "the rotations"; deleting "the"), (claim 1, line 14, "the projection of said target"; replacing "the" with -a- ), (claim 1, line 16, "the amount of translation"; replacing "the" with -an- ), (claim 1, lines 17-18, "the amount of rotation"; replacing "the" with -an- ), (claim 1, line 26, "said pair of out-of-plane"; replacing "said" with -the- ), (claim 1, line 29, "said parameters"; inserting -in-plane and out-of-plane- before "parameters"), (claim 3, line 4, "radiographs"; replacing "radiographs" with -radiograph- ), (claim 3, line 5, "the radiographic image"; replacing "the" with -a- ), (claim 11, lines 1-2, "the in-plane rotation parameters"; replacing "parameters" with -parameter- ), (claim 14, lines 1-2, "said predetermined accuracy"; deleting "predetermined"), (claim 18, line 1, "the search space"; deleting "the"), (claim 18, line 2, "in step B"; replacing "B" with -b- ), (claim 20, line 4, "said reconstructed 2D image"; deleting "2D"), (claim 21, line 12, "said known location"; replacing "position" with -location- in line 7 of claim 21), (claim 21, line 15, "said parameters"; inserting -in-plane and out-of-plane- before "parameters"), (claim 21, lines 15-16, "the difference"; replacing "the" with -a- ), (claim 21, line 16, "said x-ray image"; replacing "x-ray" with -radiographic- ), (claim 21, line 17, "said 2D reconstructed images"; replacing

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“images” with - -image- -), (claim 21, line 18, “the rotations”; deleting “the”), (claim 21, line 20, “the projection of said target”; replacing “the” with - -a- -), (claim 21, line 22, “the amount of translation”; replacing “the” with - -an- -), (claim 21, lines 23-24, “the amount of rotation”; replacing “the” with - -an- -), (claim 22, line 5, “said pair of”; replacing “said” with - -the- -), (claim 30, line 2, “the in-plane rotation parameters”; replacing “parameters” with - -parameter- -), and (claim 35, lines 1-2, “said means for performing a 1D search”; changing the dependency from claim 21 to claim 22).

For purposes of examination, the claims have been treated as such. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 21, 23-25, and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schweikard et al. (US Patent Application Publication 2004/0092815) in view of Miller et al. (US Patent 5117829) and Penney et al. (“A Comparison of Similarity Measures for Use in 2-D-3-D Medical Image Registration”).

8. Regarding claim 21, Schweikard et al. discloses a system comprising means for providing 3D scan data of a target (paragraph 36), a radiation source for generating at least one

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radiographic imaging beam (Fig. 1, #32A, and paragraph 39), an imaging system for generating a 2D radiographic image (Fig. 1, #34, and paragraph 27) of a target in near real time (paragraph 24, lines 1-2), and means for generating at least one 2D reconstructed image, using a known angle of an imaging beam (paragraph 39, lines 3-6, and paragraph 45).

However, Schweikard et al. does not disclose means for generating at least one reconstructed image, using a known angle, location, and intensity, and determination of a set of parameters ( $x$ ,  $y$ ,  $\theta$ ,  $r$ , and  $\phi$ ) representing a difference in the position of a target shown in a radiographic image as compared to a position of the target as shown by a reconstructed image.

Miller et al. teaches generating at least one reconstructed image, using a known angle, location, and intensity (col. 3, lines 50-66). Penney et al. teaches determination of a set of parameters ( $x$ ,  $y$ ,  $\theta$ ,  $r$ , and  $\phi$ ) representing a difference in the position of a target shown in a radiographic image as compared to a position of the target as shown by a reconstructed image (page 592, col. 1, paragraph 2, through col. 2, paragraph 1).

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the apparatus of Schweikard et al. with the known angle, location, and intensity of Miller et al., since one would be motivated to make such a modification to advantageously provide data for formulating a plan (col. 3, lines 45-46) as implied from Miller et al.

It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to incorporate the apparatus of Schweikard et al. with the determination of parameters of Penney et al., since one would be motivated to make such a modification to reduce computing time (page 592, col. 2, paragraph 3) as implied from Penney et al.

9. Regarding claim 23, Schweikard et al. further discloses an x-ray source (paragraph 27), a 2D x-ray image (paragraph 44), and a reconstructed image comprising a 2D DRR (paragraph 38, last 3 lines).

10. Regarding claims 24 and 25, Schweikard et al. further teaches equivalent means for determining a plurality of  $N_R$  and  $N_\phi$  of out-of-plane rotation angles, respectively for said rotational parameters, generating a plurality of  $N_R * N_\phi$  of 2D reference images, one reference image for each of said plurality  $N_R$  and  $N_\phi$  of said out-of-plane rotation angles, and generating offline a plurality of in-plane rotated 2D references images by performing a series of in-plane rotations on said reconstructed image (paragraph 39).

11. Regarding claim 34, Schweikard et al. further discloses 3D scan data comprising at least one of CT scan data, MRI scan data, and PET data (Abstract, lines 11-13).

***Allowable Subject Matter***

12. Claims 1-20 contain allowable subject matter. Claims 22-33 and 35-37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

13. The following is a statement of reasons for the indication of allowable subject matter:



Regarding claim 1, prior art does not disclose or fairly suggest a method including the steps of determining the value of in-plane transformation parameters  $(x, y, \theta)$  and out-of-plane rotational parameters  $(r, \phi)$  for registering a reconstructed image onto an x-ray image, said parameters representing a difference in position of a target as shown in said x-ray image, as compared to the position of the target as shown by said image reconstructed from 3D scan data, obtaining an initial estimate for in-plane transformation parameters  $(x, y, \theta)$  by multi-level matching in three dimensions, between an x-ray image and a reconstructed image, based on parameters estimated in step a, performing an initial search in one dimension for each of the pair of out-of-plane rotation parameters  $(r, \phi)$ , and iteratively refining said in-plane parameters  $(x, y, \theta)$  and said out-of-plane parameters  $(r, \phi)$  until said in-plane and out-of-plane parameters converge to a desired accuracy, in combination with all the limitations in the claim. Claims 2-19 contain allowable subject matter by virtue of their dependency.

Regarding claim 22, prior art does not disclose or fairly suggest an apparatus including software for determining a set of in-plane transformation parameters  $(x, y, \theta)$  and out-of-plane rotational parameters  $(r, \phi)$  representing a difference in a position of a target as shown in a radiographic image as compared to the position of the target as shown by a 2D reconstructed image and for determining in-plane and out-of-plane rotational parameters comprising means for performing a 3D multi-level matching to determine an initial estimate for in-plane transformation parameters  $(x, y, \theta)$ , means for performing a 1D search for each of the pair of out-of-plane rotation parameters  $(r, \phi)$  based on initially estimated in-plane parameters  $(x, y, \theta)$ , and means for iteratively refining said in-plane parameters  $(x, y, \theta)$  and said out-of-plane parameters  $(r, \phi)$ , until a

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desired accuracy is reached, in combination with all the limitations in the claim. Claims 26-33 and 35-37 contain allowable subject matter by virtue of their dependency.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Cheng Glen Kao whose telephone number is (571) 272-2492. The examiner can normally be reached on M - F (9 am to 5 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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